EYES SAVED IN INDUSTRY

THE EXPERIENCE OF 583 COMPANIES

—Courtesy of National Safety Council

National Society for the Prevention of Blindness

Publication 62

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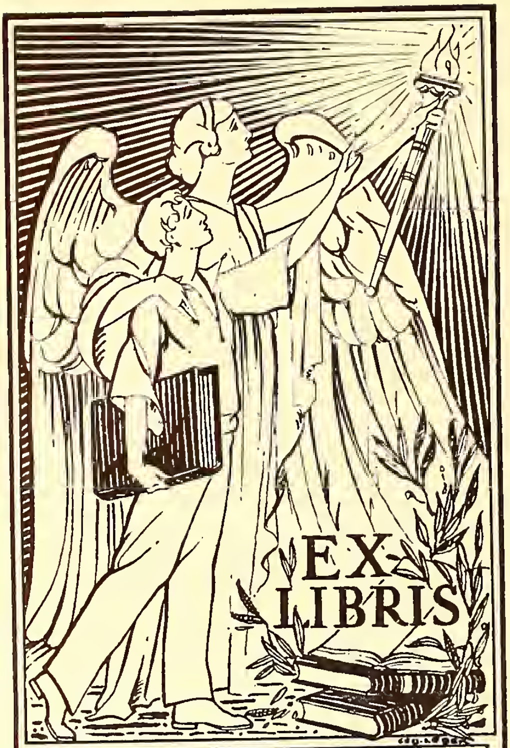

AMERICAN FOUNDATION
FOR THE BLIND INC.

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NATIONAL SOCIETY FOR THE PREVENTION OF BLINDNESS,
370 7th Ave., New York City

FROM: The National Society for the Prevention of Blindness, 370 Seventh Avenue, New York City.

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New York City, Sept. 15-----How more than 10,000 eyes and at least $46,000,000 were saved in two recent years among 583 plants, employing a total of half a million workmen, is told in the report of a study entitled "Eyes Saved in Industry," published here today (Sept. 15) by the National Society for the Prevention of Blindness and the National Safety Council. The two organizations set out to discover the total of authenticated cases of workmen's eyes saved from serious injury or destruction through the use of goggles or headmasks; as these figures apply only to the corporations with definite records, there can be only conjecture as to the number of eyes actually saved by protective devices in all American industry.

The survey analyzes the records kept by the corporations during 1926 and 1927, disclosing that in addition to the financial economy 2,757 men and women were saved from serious injury or total blindness in both eyes during the two years. There were 4,654

recorded instances of workmen being saved from a similar fate to one eye, making a total of 10,168 eyes saved from destruction or serious injury.

"In this study, the first of its kind ever made," explained Lewis H. Carris, Managing Director of the National Society for the Prevention of Blindness, "it was assumed that an object which hit a goggle lens with such force as to pierce or shatter the lens would most certainly have so damaged the eye, if the goggles had not been worn, as to cause complete or nearly complete loss of vision. It was assumed, further, that every instance of a goggle lens bespattered by molten metal or by corrosive or otherwise injurious chemicals, represented an eye saved."

"The increase in the use of destructive chemicals in industry during recent years," said Mr. Carris, "is reflected in the data from miscellaneous manufacturing plants which recorded the spattering of both lenses with molten metal or injurious chemicals in the case of one employee out of every hundred in the industry within a year. In practically all these instances the glass lens was so badly damaged by chemicals or molten metal that it had to be replaced. Often even the frame of the goggles or the entire headmask had to be discarded.

"Much has been said concerning the number of eyes lost in industry, the cost of industrial eye injuries, and the extent of blindness attributable to the eye hazards of industrial occupations. Little has been said concerning the number of eyes saved in industry, the economic gain of this saving to employer, employee and nation, or the extent to which blindness from industrial causes may

be averted. Little has been said concerning these matters because practically no authentic data covering the experience of any large group of industries was available until this study was made.

"It is, of course, impossible to interpret accurately in terms of dollars the cost of blindness, or the gain resulting from concrete instances of prevention of blindness. Workmen's compensation laws, however, set certain arbitrary values on sight; and the experience of insurance companies and of large numbers of employers has provided a formula for arriving at estimates of the incidental cost of industrial accidents. It is, therefore, possible to arrive at some conclusions concerning the economic saving to industry, to employees, and to the country at large, resulting from the saving of eyes recorded in this study.

"The eye hazards of industry have come to be one of the most serious causes of blindness in America. There is, in fact, considerable ground for the belief that each year more persons are permanently robbed of their sight by occupational hazards than by any other major cause of blindness.

"This is due largely to the fact that innumerable persons, employers and employees alike, still do not realize, or do not believe, that it is possible to prevent accidental eye injuries in the particular occupations in which they are engaged. It is due also to the failure on the part of employers or employees and communities at large to appreciate the tremendous financial loss resulting from the blinding of men and women in industry.

"Despite the splendid accomplishments of many individual firms in the prevention of accidents in general, and specifically in the prevention of eye accidents, such accidents are still considered

by many persons inherent or unavoidable accompaniments of certain industrial processes. Despite the tremendous financial savings through accident prevention publicly and authentically reported by some of the leading industrial concerns of America, there are still thousands of employers who regard as an unavoidable (though evil) necessity the payment of thousands upon thousands of dollars for the destruction or injury of the eyes of their employees.

"That these are misconceptions; that industrial eye injuries are largely preventable; and that their prevention is productive of enormous savings to employer, employee and the nation, are convincingly demonstrated in the findings of this study and the interpretation of their significance.

"The saving of sight referred to in the study is necessarily largely hypothetical. Any one acquainted with industrial processes, however, will realize that these recorded instances of the prevention of blindness and serious injury represent only a small percentage of the total number of cases in which sight is clearly saved through the use of proper protective devices. For each instance in which a goggle lens is shattered or pierced by flying objects there are scores, if not hundreds, of instances in which the goggle lens stops the flight of an object which would have pierced the unprotected eye with disastrous results.

"The comments volunteered by safety engineers and plant managers in this inquiry indicate that there were thousands upon thousands of instances in which tiny fragments of metal or mineral were imbedded in or fused with the goggle lenses and that a high percentage of these instances represents the prevention of blindness or of serious eye injuries.

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"Many plants reported they were using non-shatterable lenses. These and, in fact, the lenses of ordinary goggles and masks may be struck dozens of times by large pieces of metal without being pierced or shattered. Any estimate of the number of eyes saved in industry based on the record of goggle lenses broken, shattered or spattered with molten metal or destructive chemicals while in use is, therefore, most conservative."

Industries in the survey included the following:

166 metal producing or metal fabricating companies;
149 plants engaged in miscellaneous forms of manufacture;
66 in chemical and allied industries;
53 operating with lumber, cement, and other building materials;
42 mining, quarrying, and smelting properties;
35 railways and allied companies;
25 plants in the automotive and allied industries;
10 foundries and machine shops;
8 in the paint and oil industry;
8 in the glass and allied industries;
7 in paper and allied trades;
6 in locomotive and car-building operations;
4 in the rubber and allied industries;
3 in construction and structural industries; and
1 food packing plant.

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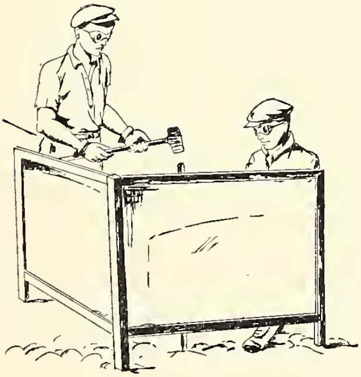
EYES SAVED IN INDUSTRY

The Experience of 583 Companies

A Study Conducted Jointly
by
The National Safety Council
and
The National Society for the
Prevention of Blindness



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Foreword

The eye hazards of industry have come to be one of the most serious causes of blindness in America. There is, in fact, considerable ground for the belief that each year more persons are permanently robbed of their sight by occupational hazards than by any other major cause of blindness.

This is due largely to the fact that innumerable persons, employers and employees alike, still do not realize, or do not believe, that it is possible to prevent accidental eye injuries in the particular occupations in which they are engaged. It is due also to the failure on the part of employers or employees and communities at large to appreciate the tremendous financial loss resulting from the blinding of men and women in industry.

Despite the splendid accomplishments of many individual firms in the prevention of accidents in general, and specifically in the prevention of eye accidents, such accidents are still considered by many persons inherent or unavoidable accompaniments of certain industrial processes. Despite the tremendous financial savings through accident prevention publicly and authentically reported by some of the leading industrial concerns of America, there are still thousands of employers who regard as an unavoidable (though evil) necessity the payment of thousands upon thousands of dollars for the destruction or injury of the eyes of their employees.

That these are misconceptions; that industrial eye injuries are largely preventable; and that their prevention is productive of enormous savings to employer, employee and the nation, are convincingly demonstrated in the findings of this study and the interpretation of their significance.

This report may, therefore, be read with profit by every employer; by men and women in industry; by plant managers, superintendents and foremen; and by industrial physicians, surgeons and nurses. It should be of interest also to all other persons concerned with safeguarding the health of working men and women or to those concerned with the financial affairs of individual industries, industrial employees, or taxpayers in general.

The study was made and the report written by Louis Resnick, Industrial Relations Director of the National Society for the Prevention of Blindness.

F. Park Lewis, M.D.
Vice-President, National Society for the Prevention of Blindness

Eyes Saved in Industry

Much has been said concerning the number of eyes *lost* in industry, the cost of industrial eye injuries, and the extent of blindness attributable to the eye hazards of industrial occupations. Little has been said concerning the number of eyes *saved* in industry, the economic gain of this saving to employer, employee and nation, or the extent to which blindness from industrial causes may be averted. Little has been said concerning these matters because practically no authentic data covering the experience of any large group of industries have thus far been available.

In an effort to secure such data, the National Society for the Prevention of Blindness and the National Safety Council in 1928 jointly undertook an inquiry concerning the known cases of eyes saved in industry.

Method of Study.—The most commonly used, and perhaps the most scientific, method of calculating accomplishment in accident prevention is to compare the accident severity rate[1] and frequency rate[2] of a plant during one year with similar rates of previous years. No large number of plants, however, keep records of eye accidents on this or on any other comparable basis. Furthermore, comparison of severity rates would be influenced by all the minor accidents which had resulted in any lost time on the part of the injured workmen. Finally, all estimates of lives, limbs and eyes saved, which are based on comparison of accident frequency or accident severity rates, seem, to many persons, theoretic savings only.

For the purposes of this study it was decided to seek more substantial evidence of eyes saved in industry. The following six items were, therefore, incorporated in a questionnaire:

How many employees in your plant during 1926 and 1927 have had one lens in their goggles shattered or pierced by flying metal while in use?

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[1] Accident severity rate is number of days lost per thousand man-hours worked.

[2] Accident frequency rate is the number of lost-time accidents per million man-hours worked.

How many employees in your plant during 1926 and 1927 had both lenses of their goggles shattered or pierced by flying metal while in use?

How many employees in your plant during 1926 and 1927 had one goggle lens spattered with molten metal or injurious chemicals while in use?

How many employees in your plant during 1926 and 1927 had both goggle lenses spattered with molten metal or injurious chemicals while in use?

How many employees in your plant during 1926 and 1927 had one goggle lens pierced or shattered by flying tools or flying objects other than fragments of metal while in use?

How many employees in your plant during 1926 and 1927 had both goggle lenses pierced by flying tools or flying objects other than fragments of metal while in use?

It was assumed that an object which hit a goggle lens with such force as to pierce or shatter the lens would most certainly have so damaged the eye, if the goggles had not been worn, as to cause complete or nearly complete loss of vision. It was assumed that every instance of a goggle lens bespattered by molten metal or by corrosive or otherwise injurious chemicals, represented an eye saved.

The question of whether this assumption is warranted was submitted to the men responsible for accident prevention in five of the largest industrial organizations in America and to the headquarters staff of the National Safety Council. Their judgment, as reported in the pages that follow, was unanimously in the affirmative. It was pointed out by several safety engineers that "the goggle lens does not have to be broken to indicate that an eye has been saved." The question of this assumption was also raised with a number of ophthalmologists and industrial surgeons, all of whom agreed that it was a warranted assumption.

The questionnaire was sent by the Society to some 1,800 industrial concerns, representing the entire membership of the National Safety Council in the following industries: Metals, chemical, quarrying, automotive, steam railroad, cement, and mining. These are the industries in which serious eye hazards are most prevalent. It should be noted in passing, however, that no industrial occupation is altogether free of such hazards. Wherever men and women are at work there is the danger of injury to the eye from flying fragments of raw materials and of manufactured products, from falling tools and other objects, from the splashing of injurious chemicals and even from horse-play.

Extent of Inquiry.—In response to the questionnaire, data sufficiently complete to be considered in this analysis were secured for the years 1926 and 1927 from 583 plants, employing an aggregate of 578,396 men. Among these were 166 metal producing or metal fabricating companies; 149 plants engaged in miscellaneous forms of manufacture; 66 in chemical and allied industries; 53 operating with lumber, cement, and other building materials; 42 mining, quarrying, and smelting properties; 35 railways and allied companies; 25 plants in the automotive and allied industries; 10 foundries and machine shops; eight in the paint and oil industry; eight in the glass and allied industries; seven in paper and allied trades; six in locomotive and car-building operations; four in the rubber and allied industries; three in construction and structural industries; and one food packing plant.

In addition to the rather complete data from these 583 companies, estimates of the number of eyes saved in their plants were received from approximately 100 concerns which reported that they kept no records of the type called for. While these estimates are not included in the tabulations that follow, they are indicative of the many splendid but unrecorded accomplishments of the organized effort to reduce the casualties of industry. Typical estimates of this character will be found in Appendix I.

The point of view of the National Society for the Prevention of Blindness on this subject, first stated in 1924 in its book, *Eye Hazards in Industrial Occupations*, is here reiterated:

> "Goggles at best are a handicap; the first effort, therefore, should be directed toward elimination of the hazard itself by revising the process of manufacture, by redesigning the machine or tool, or by guarding the machine or tool at the point of operation."

It was, therefore, gratifying to note in the remarks accompanying the returned questionnaires frequent references to the guarding of machines at the point of operation and some instances of revision of process in the interest of accident prevention.

Analysis of the detailed data shows that during 1927, in 583 plants, 1,356 men and women experienced the sensation of having one lens in the goggles or other protective devices they were wearing shattered or pierced by a fragment of flying metal.

What happened in practically all of these cases is vividly shown in Figure I.

During the same year 283 men had the even more terrifying experience of being struck by such a large piece of metal that both lenses of their goggles or headmask were shattered or pierced.

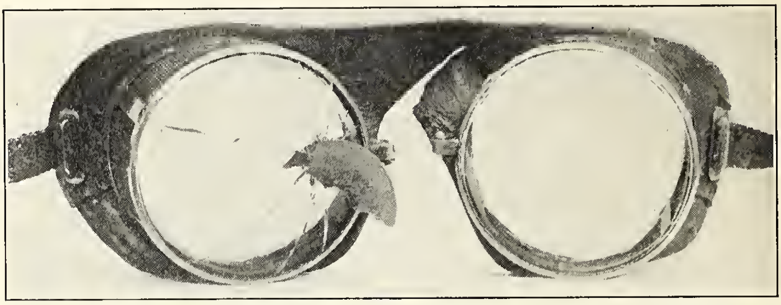


FIGURE I.—Goggles Showing Piece of Spacing Washer of Emery Wheel Dresser which Broke While Being Used, Piercing the Glass

Among these 583 plants, there were recorded for the same year 1,003 instances of one lens in the goggles or headmask worn by an employee at work being spattered with molten metal or injurious chemicals. And in the same period in these plants, 1,614 men and women had both lenses of their goggles or headmask spattered with molten metal or corrosive chemicals while they were at work, with the result illustrated in Figure II.

During this year in the same plants, 291 employees were struck by flying tools and other large objects, not including fragments of metal, with such force that one lens of their goggles or headmask was pierced or shattered; 77 other men had both lenses shattered or pierced by flying tools or other heavy objects.

Number of Workers Saved from Loss of One or Both Eyes.—All told, there were definitely recorded during 1927 cases of 2,650 workers who had one lens pierced, shattered, or spattered with molten metal or injurious chemicals and 1,974 men and women who had both lenses of their goggles or headmasks pierced, shattered or spattered while in use—a total of 4,624 cases. During the previous year, 1926, a total of 2,787 cases of such damage to goggles and masks were reported in the returned questionnaires, making a grand total of 7,411 cases in two years.

There can be little doubt that in each of these 7,411 instances the injury would have led to the complete loss of vision in one or both eyes or to very serious injury of the eyes. This is true despite the great progress that has been made in recent years in the development of electromagnets and other devices for withdrawing metal fragments from injured eyes, and despite other progress in the science of ophthalmology.

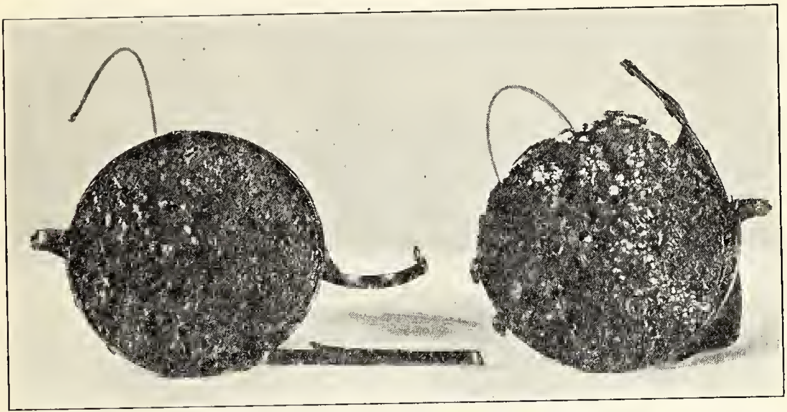


FIGURE II.—An Accidental Splash of Molten Metal Ruined these Lenses and Burnt the Workman's Face, but the Goggles Saved His Eyes.

The returns are tabulated according to industry, and type of injury averted, in Tables I and II.

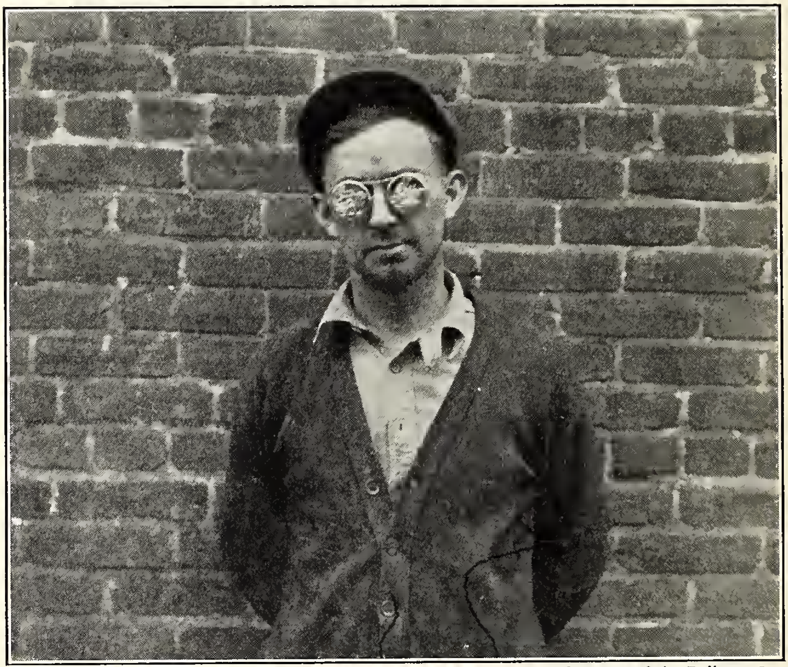
Monetary Value of Sight.—It is, of course, impossible to interpret accurately in terms of dollars the cost of blindness, or the gain resulting from concrete instances of prevention of blindness. Workmen's compensation laws, however, set certain arbitrary values on sight; and the experience of insurance companies and of large numbers of employers has provided a formula for arriving at estimates of the incidental cost of industrial accidents. It is, therefore, possible to arrive at some conclusions concerning the economic saving to industry, to employees, and to the country at large, resulting from the saving of eyes recorded in this study.

There is little uniformity in the valuations on sight set in the workmen's compensation laws of various states. The percentage of salary allowed for such injuries, the number of weeks in which compensation is paid for loss of one or both eyes, and the maximum payments allowed, vary from state to state.

Saving to Employers.—The average compensation for loss of one eye, however, seems to be about $1,800, and the average compensation for loss of sight of both eyes is about $3,500. On this basis the 583 plants covered by this study saved $8,377,200 in workmen's compensation during 1926 and 1927 by saving

4,654 single eyes. These companies saved themselves an additional $9,649,500 by saving 2,757 men from total blindness. The combined saving in compensation costs alone, therefore, is $18,026,700.

Saving to Employees.—Let us consider such money savings to the workman as can be definitely located. In most states, compensation for loss of one eye is 66 per cent of the average weekly wage of the injured employee, and this is paid for periods ranging from 50 to 125 weeks, the median being 87½ weeks. The injured workman, therefore, loses at least a third of his wage. On the basis of an average weekly wage of $30, there is indicated a wage loss of $875 for each workman who has lost an eye as the result of an industrial accident,—the difference between the amount of compensation received during his period of disability and the wages he would have received if he had not been disabled. For the 4,654 employees who would have lost an eye each, during 1926 and 1927 in these 583 plants, there is indicated a direct saving of $4,072,230.



Courtesy of the Pullman Co.

FIGURE III.—Splashing Solder Struck Both Lenses of the Goggles but the Eyes Were Saved.

TABLE I.—HOW 4,654 EYES WERE SAVED IN TWO YEARS

Nature of Industry	No. of Plants	No. of Employees	One Lens Shattered or Pierced by Flying Metal		One Lens Spattered with Molten Metal or Injurious Chemicals		One Lens Pierced or Shattered by Flying Tools or Flying Objects Other Than Fragments of Metal		Totals	
			1927	1926	1927	1926	1927	1926	1927	1926
Steel and Other Metals	166	109,577	747	527	587	416	70	47	1,404	990
Miscellaneous Manufacturing	149	83,864	190	147	78	47	31	18	299	212
Mining, Quarrying and Smelting	42	21,617	18	16	11	7	25	9	54	32
Railroads and Allied Industries	35	191,600	247	204	129	100	77	62	453	366
Lumber, Cement and Building Materials	53	7,463	18	9	34	8	24	16	76	33
Chemicals and Allied Industries	66	34,607	20	14	109	93	14	16	143	123
Auto and Allied Industries	25	52,828	29	32	18	6	18	7	65	45
Paper and Allied Industries	7	4,421	3	2	4	3	8	6	15	11
Rubber, Batteries and Allied Industries	4	3,169	0	0	3	5	0	0	3	5
Foundry and Machine Works	10	1,685	10	12	1	0	1	0	12	12
Paint and Oil Industries	8	7,896	13	17	4	6	2	3	19	26
Packing and Food Plants	1	8,000	1	0	1	0	0	0	2	0
Locomotive and Car Building	6	43,667	53	93	18	17	13	31	84	141
Glass and Allied Industries	8	6,886	6	2	6	3	8	3	20	8
Building and Structural Industries	3	1,116	1	0	0	0	0	0	1	0
Totals	583	578,396	1,356	1,075	1,003	711	291	218	2,650	2,004

TABLE II.—HOW 2,757 MEN AND WOMEN WERE SAVED FROM SERIOUS INJURY TO BOTH EYES OR TOTAL BLINDNESS

Nature of Industry	No. of Plants	No. of Employees	Both Lenses Shattered or Pierced by Flying Metal		Both Lenses Spattered with Molten Metal or Injurious Chemicals		Both Lenses Pierced or Shattered by Flying Tools or Flying Objects Other Than Fragments of Metal		Totals	
			1927	1926	1927	1926	1927	1926	1927	1926
Steel and Other Metals	166	109,577	57	20	381	268	11	16	449	304
Miscellaneous Manufacturing	149	83,864	112	5	718	83	1	0	831	88
Mining, Quarrying and Smelting	42	21,617	0	0	137	4	1	0	138	4
Railroads and Allied Industries	35	191,600	81	86	220	169	11	6	312	261
Lumber, Cement and Building Materials	53	7,463	2	0	48	7	1	1	51	8
Chemicals and Allied Industries	66	34,607	0	0	71	67	1	0	72	67
Auto and Allied Industries	25	52,828	29	7	9	4	48	1	86	12
Paper and Allied Industries	7	4,421	1	0	2	1	0	0	3	1
Rubber, Batteries and Allied Industries	4	3,169	0	0	2	2	0	0	2	2
Foundry and Machine Works	10	1,685	0	0	2	2	0	0	2	2
Paint and Oil Industries	8	7,896	0	0	2	1	0	0	2	1
Locomotive and Car Building	6	43,667	1	6	21	23	3	0	25	29
Glass and Allied Industries	8	6,886	0	2	1	2	0	0	1	4
Totals	579	569,280	283	126	1,614	633	77	24	1,974	783

The average compensation for total loss of sight (both eyes) is 66 per cent of the average wage of the employee for periods ranging from 240 weeks to the remainder of his life. On the basis of the minimum, 240 weeks, and using again the average weekly wage of $30, we find for the worker who gets 66 per cent compensation for total loss of sight a wage loss of $2,400 in those 240 weeks. As 2,757 employees were saved from total blindness in the plants covered by this study, we may record a saving of $6,616,800 in wages for these fortunate men and women. The total saving to the workmen would then be $10,689,030.

Impressive as this figure may seem, that it is only a fraction of the actual saving to the workman becomes apparent when we consider the extent to which the loss of one eye, and certainly total blindness, reduces the earning capacity of any man or woman. These $10,000,000 represent only the difference between compensation received and what would have been the wages of these workers if they had not been injured. Imagine what happens to most one-eyed or blinded workers when compensation ceases.

Cost of Eye Injuries.—The direct losses averted in these cases are: $18,000,000 in compensation saved to 583 employers, and $10,000,000 in wages saved to 7,431 employees.

But even this does not tell the whole story. There is now general acceptance among safety engineers, insurance companies and industrial executives of the theory, enunciated several years ago by H. W. Heinrich, Assistant Superintendent of the Engineering and Inspection Division, The Travelers Insurance Company, that the incidental cost of eye injuries is considerably greater than the compensation and medical cost. Mr. Heinrich includes in the accidental cost such items as:

1. Cost of lost time of injured employee.
2. Cost of time lost by other employees who stop work,
   (a) out of curiosity,
   (b) out of sympathy,
   (c) to assist injured employee, or
   (d) for other reasons.
3. Cost of time lost by foremen, supervisors, or other executives as follows:
   (a) assisting injured employee,
   (b) investigating the cause of the accident,
   (c) arranging for the injured employee's production to be continued by some other employee,
   (d) selecting, training, or breaking-in a new employee to replace the injured employee, and

(e) preparing state accident reports, or attending hearings before industrial commissioners.

4. Cost of time spent on the case by first-aid attendant and hospital department staff, when this time is not compensated by insurance.
5. Cost due to injury to the machine, tools, or other property or to the spoilage of material.
6. Incidental cost due to interference with production, failure to fill orders on time, loss of bonuses, payment of forfeits, and other similar causes.
7. Cost to employer under employee welfare and benefit systems.
8. Cost to employer in continuing the wages of the injured employee in full, after his return—even though the services of the employee (who is not yet fully recovered) may for a time be worth only about half of their normal value.
9. Cost due to the loss of profit on the injured employee's productivity, and on idle machines.
10. Cost of subsequent injuries that occur in consequence of the excitement or weakened morale due to the original accident.
11. Overhead cost per injured employee—the expense of light, heat, rent, and other such items continues while the injured employee is a non-producer.

Though there is, at present, no means of arriving at any tangible measure of these indirect costs, Mr. Heinrich estimates them, in the aggregate, to be four times the direct cost, that of compensation and medical expense. Let us be conservative and say that the incidental loss to industry is merely equal to the direct loss, $18,000,000 in this case.

Saving to the Nation.—What has the nation and state saved in this situation? Here, too, unfortunately, there is no authentic basis of calculation. However, the Federal Bureau for Vocational Education reports that the average cost of retraining a disabled person is $300.[1] Overlooking in this instance altogether the 4,654 men and women who might have lost an eye each, and taking into account only the 2,757 employees who were saved from total blindness, there is indicated a potential saving of more than $800,000 to the federal and state agencies for the rehabilitation of disabled persons.

There are many other evidences of loss to the individual and to the country resulting from serious injury or permanent disability of industrial workers. There is hardly need of continuing the sad story here. A tabulation of the foregoing estimates shows a net saving to employer, employee, and the nation of more than $46,000,000 through the saving of eyes recorded in this study among 583 plants employing little over half a million men and women.

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[1] "Vocational Rehabilitation," by John Aubel Kratz, Chief, Vocational Rehabilitation Service, Federal Board For Vocational Education.

Opinion of Safety Engineers.—The analysis of these data was laid before a group of safety engineers constituting the Industrial Advisory Committee of the National Society for the Prevention of Blindness, and questions were raised as to the likelihood of a destructive injury to the eyes of these workmen if they had not worn goggles. The members of this Committee are:

C. L. Close, Manager, Bureau of Safety, Sanitation and Welfare, United States Steel Corporation.

Charles E. Hill, General Safety Agent, New York Central Lines.

Roy S. Bonsib, Chief Safety Inspector, Standard Oil Co. of New Jersey.

Harry Guilbert, Director, Bureau of Safety and Welfare, The Pullman Company.

Leo D. Woedtke, Fred T. Ley & Co., Inc.

The analysis and query were also formally submitted to the National Safety Council through its managing director, William Cameron. The headquarters staff of the Safety Council replied "Yes" to the question, "Are we justified in assuming that every goggle lens pierced, shattered or spattered by flying metal, molten metal or destructive chemical represents an eye saved?" The same question submitted to the members of the National Society's Advisory Committee on Industrial Hazards brought the following replies:

From C. L. Close, United States Steel Corporation:

"I think you are justified . . . in assuming that every time a goggle lens has been shattered, pierced, or spattered by molten metal or corrosive chemical while in use, an eye has been saved from serious injury or destruction. Of course, it is almost impossible to know that in each and every instance an eye has been saved, but the probabilities are, under the conditions you mention, that an eye would be seriously injured or lost, and I think you are safe in assuming that this would be true.

"There are also many other cases that you can not include in your estimate of eyes saved, where an object hits the lens of the goggle without enough force to break it, but near the breaking point, which would more than likely cause a serious injury to the eye, or complete loss, if goggles had not been worn, so that your assumption, I think, is conservative.

"In my opinion your estimates of the financial gain resulting from eyes saved are warranted and likewise conservative."

From C. E. Hill, New York Central Lines:

"I think ordinarily we are justified in assuming that every time a goggle lens has been shattered, pierced or spattered by molten metal or corrosive chemical that an eye has either been saved from destruction or from serious injury. We have had, I am sure, hundreds of such cases every year."

From R. S. Bonsib, Standard Oil Company:

"I think you are perfectly justified in assuming that every time a goggle lens has been shattered, pierced or spattered by molten metal or corrosive chemical while in use, an eye has been saved from destruction or from serious injury."

From Harry Guilbert, Pullman Company:

"Your estimates are extremely conservative."

From Leo D. Woedtke, Fred T. Ley & Co.:

"You are perfectly justified in assuming that every time a goggle lens has been shattered, pierced or spattered by molten metal or corrosive chemical while in use an eye has been saved from destruction or serious injury. . . .

"As to whether the estimates of the financial gain resulting from eyes saved are warranted, I certainly believe that they are."

Industries in Which Eyes Were Saved.—The largest number of eyes saved during 1927 was recorded in the metal industries in which 1,404 employees had one lens shattered and 449 had both lenses shattered. Next in order were the miscellaneous manufacturing plants, the records of which show 299 cases of the prevention of serious injury to or destruction of one eye and 831 cases of the prevention of serious injury to or destruction of both eyes. Among 35 railway and allied properties, 453 employees were saved from the loss of one eye each and 312 from what undoubtedly would have been total blindness.

The increase in the use of destructive chemicals in industry during recent years is reflected in the data from the miscellaneous manufacturing plants which record the spattering of both lenses with molten metal or injurious chemicals in the case of one employee out of every hundred in the industry within the year. In practically all these instances the glass lens was so badly damaged by chemicals or molten metal that it had to be replaced. Often even the frame of the goggles or the entire headmask had to be discarded. It is not difficult to imagine what would have happened in each case when we see such exhibits as Figure II.

It is recognized that the saving of sight referred to in this study is necessarily largely hypothetical. Any one acquainted with industrial processes, however, will realize that these recorded instances of the prevention of blindness and serious injury represent only a small percentage of the total number of cases in which sight is clearly saved through the use of proper protective devices. For each instance in which a goggle lens is shattered or pierced by flying objects there are scores, if not hundreds, of instances in which the goggle lens stops the flight of an object which would have pierced the unprotected eye with disastrous results.

The comments volunteered by safety engineers and plant managers in this inquiry indicate that there were thousands upon thousands of instances in which tiny fragments of metal or mineral were imbedded in or fused with the goggle lenses and that a high percentage of these instances represents the prevention of blindness or of serious eye injuries.

Many plants reported they were using non-shatterable lenses. These and, in fact, the lenses of ordinary goggles and masks may be struck dozens of times by large pieces of metal without being pierced or shattered. Any estimate of the number of eyes saved in industry based on the record of goggle lenses broken, shattered or spattered with molten metal or destructive chemicals while in use is, therefore, most conservative.

Impressive as are the figures resulting from a tabulation of records submitted in the returned questionnaires, the comments volunteered with these statistics are far more revealing of the circumstances under which some eyes are destroyed and others saved in industry. Some of these are presented in Appendix II.

Appendix I: Comments from Industrial Plants

American Steel Foundries.—". . . We have kept a record of lenses broken by flying particles for the past twelve years. In 1916 we had a record of four cases in which safety lenses were destroyed by hot metal, but that year was the last in which anything of the kind occurred.

"This does not mean that safety goggles in our plants have not stopped many particles of flying hot metal; a spark or globule of hot metal may strike a lens and not do anything but make a small pit on the surface and yet the same particle of hot metal could seriously burn an eye and in many instances cause the loss of sight. . . .

"The quality of the protective lens used in the ordinary safety goggle is much better than it was years ago, with the result that it does not break as easily and a safety goggle might deflect quite a number of flying particles before the lens would be broken. So it is impossible to tell how many eyes are actually saved by the various protective measures in use today.

"We know that we have not had as many broken lenses reported now as we did at one time, and this reduction in broken lenses is probably because of better quality of the lens and because the product that is being manufactured is being made better so that so much chipping does not have to be done and because the work is laid out in a better manner so that workmen will not be hit as often by flying chips from tools of other workmen.

"For the period of 1916 to 1927, inclusive, our record of lenses broken by flying particles is as follows: 510, 407, 286, 151, 208, 74, 95, 90, 76, 41, 43, 23; making a total of 2,004 lenses broken, and it is probably safe to say that this number of eyes were saved, because when a lens is hit hard enough to break it, such a blow would destroy the eye if it were unprotected."

General Electric Company.—". . . There are a large number of cases, undoubtedly, of goggles being struck by flying objects without any damage to the glass. The optical companies have made rapid strides in the past two years in developing extra tough glass. Two companies are putting out a tough toric lens, which, if struck in any direction except square on the center and at right angles to that particular point, would probably glance off without damaging the lens. Consequently, the number of times that employees have been struck on the goggle lens is something that I don't believe any of us have any information about.

"On the other hand, there is another type of comparison that would undoubtedly be of interest. As you well know, the goggles which were on the market ten or more years ago were, in a good many cases, not particularly comfortable, and during those times the workmen had not been sold on the goggle-wearing idea to the extent that they have been in many large industrial plants in the past few years, and consequently I think the following table—showing the number of lost-time eye accidents at our Schenectady Works during a period of the past ten years—might be illuminating in that respect:

Date	*Number*	*Date*	*Number*
1918	240	1923	55
1919	153	1924	24
1920	159	1925	13
1921	65	1926	13
1922	56	1927	7"

Keystone Steel & Wire Company.—". . . During 1925, we had four men each lose an eye in our nail mill. Previous to that year we had had others who lost their sight from the same cause and in the same mill. In a nail mill there are fine slivers flying about the machines and these would occasionally get in man's eye. Early in 1926 we put goggles on these nail mill men and we have not lost an eye since."

Tri-State Zinc and Lead Ore Producers Association.—". . . We have had two reports in the last year and a half in which hoods have saved the workmen from being burned by flying hot metal."

American Zinc Company of Tennessee.—". . . We are now making it compulsory for our employees to wear goggles when performing the following works: Oxy-Acetylene Torch; Emery Wheel; Driving or Cutting Rivets; Chipping; Cutting Wire Rope with Cleaver; Cutting Elevator Bolts; Pouring Babbitt Metal; Breaking Boulders; Blowing Out with Air Hose; Cement Gun; Operating Wood Lathe; Boring Castings (Mill); Collaring or Blowing Out Holes (Mine).

"Men performing the above work or occupation are using glass goggles with the exception of collaring or blowing out holes or breaking boulders in the mines and for these two classifications we allow the use of wire screen goggles. . . ."

A Cement Company.—". . . We have only one specific case in which we can honestly say that man's eye was saved through the use of goggles. This occurred at Plant No. 4 when quarry repairman was engaged in cutting off ⅞" rivet from quarry car, rivet struck man's goggles on the corner of one of the lenses near the frame. The glass was broken but not so that it was dangerous. The goggles saved the man's eye, without a doubt, and probably his life. If he had not worn goggles this rivet might have struck him on the temple. . . .

"While we compel employees to wear goggles at all times, we, however, are trying to stop all flying objects, molten metals, and foreign bodies at their source. We find that a great majority of eye accidents can be confined to the source by proper methods, an example being that of our Bag Department. Heretofore we compelled the use of goggles for fear of splashing cement from bags. The goggles prevented the cement from entering the eye, but struck the employees in the face. We have now exercised care in sorting our bags and find that there is no more trouble from cement flying from bags."

New York Central Lines.—". . . We, of course, keep a record of our eye cases and know to what extent we are conserving the loss of eyes. For example, during 1926 we had 47 employees on the entire New York Central Line who sustained the loss of vision of one eye. In 1927 there were 25 such cases. We include all cases of 'industrial' blindness, which, as you know, does not mean that the vision is entirely destroyed. . . .

"We receive reports frequently of instances where goggles have averted the loss of the eye. In some instances we have taken photographs of the individual whose eye had been saved in this manner, and made a bulletin out of it.

"We have approximately 175,000 employees and our eye losses are confined largely to mechanical and maintenance of way employees."

Wabash Railway Company.—". . . We have thirty or forty shops scattered over 3,000 miles of road, and sometimes goggles are shattered that I never learn of. However, frequently in making my rounds over the road, I see hung up for inspection on our safety boards goggles that have been broken.

"We formerly had quite a number of eyes lost each year, but we have adopted strict goggle rules, especially for shopmen, furnishing goggles free to employees, with prescription lenses when necessary, and then we impose discipline if they do not wear them on work known as goggle work.

"We had only one eye destroyed in 1927. This man was wearing a pair of goggles—the very best make—but when flying object struck lens, shattering lens, a small piece of glass entered his eye. We never had a year before where we did not have more than one lost eye, and I attribute this reduction in lost eyes to our use of goggles and glass shields, etc. . . ."

American Locomotive Company.—". . . During the past ten years we have vigorously enforced the use of goggles to protect workmen engaged upon work dangerous to the eyes, and as a result we know that we have saved many from loss of sight. It is nothing unusual for lenses to be badly shattered, but the number for any particular period I am sorry we cannot give.

"A few years ago it was nothing unusual for us to have accidents causing blindness; in fact, they were very frequent and for one year numbered as high as 112. These accidents have practically disappeared and it is very seldom now that we have an accident of this nature."

Ford Motor Company.—". . . Our policy has been to pick out certain good examples of goggles which have saved eyes and display same in the plant. We have not paid any attention to the actual number. . . ."

Fisher Body Corporation.—". . . We have many cases each year where employees' eyes are saved as a result of their wearing goggles. Frequently, men come into our office exhibiting goggles which have been broken, particularly by flying pieces of metal, stone, etc., and many times the goggles are the means of preventing chemicals and other liquid materials from flying into the eyes of employees.

"We also have many cases of eyes being saved from flying splinters of wood, this occurring particularly on wood work machines.

"The chief eye hazards which we encounter in this plant are flying chips of steel in our Tool and Die Making Department, flying pieces of emery in our Grinding Department, flying splinters from our various wood working machines and flying sparks from electric welders. We have probably about 1,500 men working at these occupations and are very particular to see that all of these workmen wear goggles. During an average year we use probably 2,500 pairs of goggles and, in addition to this, about 8,000 pairs of lenses.

"You might also be interested to know that we have physical examination at this plant, and are very particular that men working on any dangerous machines, such as presses and various wood work machines, have very good eyesight. Men with defective vision are, of course, not put on these machines. We think that this policy, while not necessarily eliminating so many eye accidents, does eliminate other accidents which these men with poor vision might sustain were they put on these dangerous machines. . . ."

Appendix II: Additional Information from Plants

The Westmoreland Coal Co., of Irwin, Pa., submitted a record including names and dates showing 27 instances in which the eye of a workman was saved by the wearing of goggles and one case in which an eye was lost. The latter instance, told in two sentences, is the nub of the whole problem of eye protection in industry:

"One eye lost—John S. This man had his goggles in his pocket and had started to work, without putting them on, intending to put them on later. He was too late; a flying rivet struck him in the eye."

The Monongahela Railway Company reports the following which occurred on December 19, 1927:

"Acetylene burner was heating rivets under tank of engine and accidentally turned around and let torch strike another employee across the face, burning him on forehead.

"Our Chief Surgeon advised that the fact that this man was wearing goggles saved both of his eyes. While the burns were not severe, there is no question but what the wearing of goggles saved this employee's eyes."

The Marion Malleable Iron Works reported that with 75 men engaged in chipping and grinding it is necessary to replace "six to eight dozen goggles a year" because of broken or pitted lenses, an average of about one pair per man each year.

Another company writes:

"In connection with our campaign against eye accidents, an 'Investigating Board,' consisting of Superintendent, Safety Inspector, and Chairman of the Safety Committee, was formed. This board holds a hearing on each accident requiring the services of a doctor, analyzes the cause and places the responsibility for the accident. It is customary for the foremen of the department in which the accident occurred to attend these meetings accompanied by the man who was injured.

"Our experience over a period of two years had developed the following as the principal causes of eye injuries:

"Grinding without goggles.

"Failure to keep eyes out of line with cutting tools.

"Failure to keep eyes out of line when kicking belts on machines.

"Failure to wear goggles while standing waiting to use grinding wheel.
"Bringing face close to cutting tools without wearing goggles.
"Failure to turn head when passing grinding wheel in use.
"Allowing steel chips to accumulate around belting.
"Rubbing eyes with unclean hands.
"Shaking steel chips out of unclean rags.
"Striking boxes against objects to clean them, thereby throwing particles into eye.
"An incidental benefit is derived from these hearings, in that employees leaving a board hearing act as salesmen to the rest of the employees of their department who are naturally curious as to what was said and done at the hearing."

The Pauly Jail Building Company write:

"We protect all of our punch presses with shatter proof shields to guard against (flying fragments of) punches breaking. Our men after having a punch break do not have to be urged to use the shield, particularly after one man had a piece of a broken punch lodge in his jaw. We have similar shields on emery wheels. Every man is given a pair of shatter proof goggles when he starts. We also provide special lenses for the older men."

R. Hoe & Company, manufacturers of printing presses, write:

"We have about 30 men who wear goggles all day while grinding bits for circular saws. None of the particles flying off (in this operation) is enough to break a goggle glass, but might easily cost the sight of an eye or a good percentage loss of an eye. In other words, the goggle does not have to have the glass broken to indicate that an eye was *saved*. Sand blast men and welding men wear helmets. Every man in the entire shop has a pair of goggles issued to him. We had 481 minor eye cases last year, of which only two caused a partial loss of eyesight."

Bessemer Limestone & Cement Company write:

"I have one case in mind, occurring about six months ago, in which a man was injured by the explosion of hot babbitt metal; his face was badly burnt, but his eyes were protected with goggles, the lenses of which were covered with the metal. Since that time we have supplied and insist upon the use of helmets for this work."

Read!

How one company reduced its compensation for eye injuries from $12,000 a year to nothing a year, with twice as many men at work.

◆

How another company cut its eye compensation costs from $1,000 a year to $3.

◆

How the United States Steel Corporation keeps trachoma and other eye diseases out of its plants.

◆

How to conduct an intensive sight-saving campaign among your employees.

◆

How to overcome workmen's objections to goggles.

◆

How to eliminate eyestrain.

◆

How to render first-aid treatment for eye injuries.

◆

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